

ABSTRACT

This invention sets forth a commercially viable diesel combustion system that meets environmentally acceptable levels of NO_x emissions (i.e. 0.2 g/bhp-hr or lower across a full map of engine speeds and loads) without the need for use of NO_x 5 aftertreatments, and simultaneously maintains engine-out PM emissions relatively close (e.g. with smoke levels at or below 3 BSN) to environmentally acceptable PM post-aftertreatment levels. The invention achieves these results by operating within a unique combination of parameters. These parameters comprise: (1) charge-air oxygen concentration below 16%, preferably between 10% and 15%, more preferably between 10 11% and 14%, and most preferably between 12% and 13.5% for virtually all engine operating conditions (but not necessarily at no-load or low load conditions), (2) fuel injection pressures at or exceeding 1800 bar, preferably exceeding 2100 bar, more preferably exceeding 2300 bar, and most preferably exceeding 2500 bar, at most engine speeds and loads, and (3) charge-air mass/fuel mass ratio between 25:1 and 45:1 for 15 medium and high loads. Furthermore, the system is preferably run continuously slightly lean of stoichiometry, providing just enough excess oxygen to facilitate completeness of combustion and to maintain an exhaust oxygen level sufficient for continuous trap regeneration at a balance point in operation.